Claims

What is claimed is:

1. A method of fabricating a dense pixel array comprising the steps of:

(a) printing a photoresist mask and applying said mask to a semiconductor material substrate to form a masked area and an unmasked area on said substrate;

(b) applying a photoresist material layer to the unmasked area of the substrate, then applying a metal layer over the photoresist material layer and the substrate, and then applying a solvent to remove the photoresist material layer and said metal layer applied over said photoresist material layer to leave a plurality of metal layers superimposed over the unmasked area of the substrate;

(c) removing the substrate to a depressed substrate surface between the metal layers formed in step (b) to form a plurality of pixels each having an upper metal layer;

(d) superimposing an insulative layer over each of the metal layers formed in step (c);

(e) forming a hole in at least one of the insulative layers formed in step (d) so as to expose the metal layer under said insulative layer; and

(f) superimposing a metallic feature over the insulative layers on a plurality of the pixels and electrically connecting said metallic feature to one of the metal layers superimposed over one of said pixels over which the metallic feature is superimposed.

2. The method of claim 1 wherein in step (a) pixel size is defined and is from 1.5 microns to 9.75 microns.

3. The method of claim 2 wherein in step (a) pixel separation is from 0.115

micron to 0.75 micron.

4. The method of claim 1 wherein in step (b) the metal is a Au/Ni/Au pixel metal.

5. The method of claim 4 wherein the metal is applied by an electron beam lithography process.

6. The method of claim 1 wherein in step (c) the pixels are formed by a reactive ion etch (RIE) process.

7. The method of claim 1 wherein in step (d) the insulative layer is a nitride layer.

8. The method of claim 7 wherein the nitride layer is comprised of a base nitride layer extending from the base surface of the substrate to the top of the pixel and a top nitride layer superimposed over the base layer and the metal layers on the pixel.

9. The method of claim 1 wherein in step (e) the hole is formed by a nitride etch process.

10. The method of claim 1 wherein in step (f) the metallic feature is an indium bump.

11. The method of claim 1 wherein in step (f) an adhesion metal composition connects the metallic feature and the metal layer supra imposed over one of the pixels.

12. A method of fabricating a dense pixel array comprising the steps of:

(a) defining the pixel size by printing a photoresist mask and applying said mask to a semiconductor material substrate to form a masked area and an unmasked area on said substrate;

(b) applying a photoresist material layer to the unmasked area of the substrate, then applying a metal layer over the photoresist material layer and the substrate, and then

applying a solvent to remove the photoresist material layer and said metal layer applied over said photoresist material layer to leave a plurality of metal layers superimposed over the unmasked area of the substrate;

(c) removing the substrate to a depressed substrate surface between the metal layers formed in step (b) to form a plurality of pixels each having an upper metal layer;

(d) superimposing a nitride insulative layer over each of the metal layers formed in step (c);

(e) forming a hole in at least one of the nitride insulative layers formed in step (d) so as to expose the metal layer under said nitride insulative layer;

(f) superimposing an indium bump over the insulative layers on a plurality of the pixels and electrically connecting said indium bump to said one the metal layers superimposed over one of said pixels over which the said indium bump is superimposed.

13. A product of a method of fabricating a dense pixel array comprising the steps of:

(a) printing a photoresist mask and applying said mask to a semiconductor material substrate to form a masked area and an unmasked area on said substrate;

(b) applying a photoresist material layer to the unmasked area of the substrate, then applying a metal layer over the photoresist material layer and the substrate and, then applying a solvent to remove the photoresist material layer and said metal layer applied over said photoresist material layer to leave a plurality of metal layers superimposed over the unmasked area of the substrate;

(c) removing the substrate to a depressed substrate surface between the metal

layers formed in step (b) to form a plurality of pixels each having an upper metal layer;

(d) superimposing an insulative layer over each of the metal layers formed in step (c);

(e) forming a hole in at least one of the insulative layers formed in step (d) so as to expose the metal layer under said insulative layer; and

(f) superimposing a metallic feature over the insulative layers on a plurality of the pixels and electrically connecting said metallic feature to one of the metal layers superimposed over one of said pixels over which the metallic feature is superimposed.

14. An opto-electronic device comprising:

a base semiconductor substrate;

a plurality of semiconductor pixels each having an upper metallic layer and extending upwardly from the base semiconductor substrate;

an insulative layer superimposed over the upper metallic layers on the pixels;

a via hole extending through the insulative layer to expose one of upper metallic layers superimposed over one of the pixels;

a metallic feature superimposed over at least one of the pixels;

a conductive material connecting said metallic features and said upper metallic layer exposed by said via hole.

15. The device of claim 14 wherein said pixels have a pixel size and said pixel size is from 1.5 microns to 9.75 microns.

16. The device of claim 15 wherein there is a pixel separation and said

separation is from 0.115 micron to 0.75 micron.

17. The device of claim 14 wherein the metallic layer is comprised of a Au/Ni/Au pixel metal.

18. The device of claim 14 wherein the insulative layer is a nitride layer.

19. The device of claim 18 wherein the nitride layer is comprised of a base nitride layer extending from the base surface of the substrate to the top of the pixel and a top nitride layer superimposed over the base layer and the metal layers on the pixel.

20. The device of claim 14 wherein the metallic feature is an indium bump.

21. An opto-electronic device comprising:

a base semi-conductor substrate;

a plurality of semiconductor pixels each having an upper metallic layer and extending upwardly from the base semiconductor substrate;

a nitride layer superimposed over the upper metallic layers on the pixels;

a via hole extending through the insulative layer to expose one of the upper metallic layers superimposed over one of the pixels;

an indium bump superimposed over at least one of the pixels;

a conductive material positioned in said via hole to electrically connect the indium bump and said upper metallic layer exposed by said via hole.